Quick Guide to Probabilistic Forecasting

Why it's the best foundation for right-sized inventory in uncertain times

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“When all you have is a hammer, everything looks like a nail.”

The same idea applies to many companies’ forecasting methods. By slapping the same rigid algorithms onto every situation without accounting for external variables and location-specific product behavior, planners end up playing a game of whack-a-mole, attempting to compensate for the issues created and perpetuated by unreliable forecasts.

Other companies are encumbered by unwieldy spreadsheets that hamper data analysis, magnify errors, and do little to counter the effects of guesstimates and crossed fingers.

In today’s world of uncertainty, supply chains require forecasting methods that can handle mountains of data and adapt quickly to increased complexity, continued shortages, and unexpected disruptions.

That’s where probabilistic forecasting comes in.

AI-driven probabilistic forecasting combines external causal data with historical and demand-relevant internal data to provide planners with a more nuanced understanding of demand patterns. This allows businesses to make intelligent decisions quickly, calibrate their forecasts to achieve maximum accuracy, and ensure a consistent, positive customer experience.

What Is Probabilistic Forecasting?

Probabilistic forecasting (sometimes called "stochastic" forecasting) doesn't just average your demand and hand you a target number.

Instead, it takes uncertainty into account and displays all the potential outcomes as probabilities that may occur. It calculates your most likely forecast, but it knows it could be wrong and shows you by how much.

This enhanced visibility and understanding of demand gives you greater control of your forecast and inventory and helps defend your supply chain from uncertainty.

How Does Probabilistic Forecasting Work?

Probabilistic forecasting helps decode uncertainty with the help of machine learning. This powerful AI technology extracts the demand signal from "noise" and analyzes multiple demand variables to identify a range of outcomes and the probability that each will occur.

The probability distribution is derived not just from the demand history of an item, but also how it was purchased–how often, in what quantity, and where. This detailed analysis achieves greater accuracy more quickly than a number derived from demand history alone.

This is a major differentiator, since this detailed look at data is not incorporated into traditional forecasting methods, but it's not the only advantage probabilistic methods have over one-number forecasts.

Why Is Probabilistic Forecasting Better Than One-Number Forecasts?

A traditional top-down forecast is created by aggregating historical demand and then using that average as your target forecast. There are two major weaknesses in this approach.

1. It's an aggregated view of demand that doesn't consider demand behavior at the item-location level.
2. By giving you only a one-number target, it's telling you "this specific thing will happen."

Let's consider how this affects your forecast and inventory.

Going Beyond Aggregates and Averages

Let's take a simple example. Say you have sold 12 tires over the course of a year.

A single number forecasting system might look at sales history for the tire's specific SKU, identify an average of one tire per month, and generate a proposal to keep one tire in stock. But this does not take into account the possibility or probability that a customer may choose to replace all four tires at once. By only having one tire in stock, the customer experience is at risk and the chance of lost sales increases.

A probabilistic method works on a more granular level, drilling down into daily demand for an item at each location, where there is usually considerable volatility. It examines order patterns (e.g., order size and frequency) and determines how much inventory to stock in order to meet demand for a specific SKU at a specific location.

So the probabilistic method may see that customers typically replace all four tires at once with occasional single flat tire replacements. It then provides you with a range of possibilities for the optimal number of tires to have on hand. This ensures that you are neither under- nor over-stocking, while still making sure you hit your service targets for that item.

Gaining a Richer Picture of Demand

A one-number forecast looks at demand history, which works beautifully if you have a rock-solid, steady demand pattern. This favors fast-moving items with little or no variation in demand. It also exhibits very black-and-white thinking.

Let's use weather as an example. Let's say you're asking, "Will it rain?"

If you live in an arid climate with little to no rainfall, chances are you won't need an umbrella today. In this case, a traditional, one-number forecast would likely tell you, "No, it will not rain," and it would be a safe bet.

But in a region with more fluctuating weather patterns, that yes-or-no mindset might leave you with very soggy socks.

Probabilistic forecasting does not answer in a yes or no format. Instead, when asked, "Will it rain today?" it gives you percentages and tells you how likely it is that it will rain and at what time. It may say, "There's a 70% chance it will not rain on your way to work, a 20% chance it will drizzle, and a 10% chance it will break rainfall records."

By providing you with this information, instead of just giving you a yes or no answer, probabilistic forecasting helps you make more informed decisions. Perhaps 70% is reasonable and you're going to wear those new shoes you just bought. Or perhaps, you'd rather not risk it and you slide on rain boots instead.

What Are the Benefits of Probabilistic Forecasting?

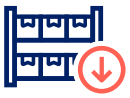
Probabilistic forecasting systems do the most accurate job of predicting the amount and type of stock to carry at the item-location level.

The probabilistic method eliminates the inaccuracies stemming from non-data-driven approximations, instead generating a real-world picture of variability that helps planners consistently calculate optimal inventory levels across their distribution networks. This in turn minimizes the amount of on-hand stock required to service demand, reducing working capital without jeopardizing the customer experience.

Its incorporation of external variables and its detailed look at demand patterns make it ideal for forecasting products with intermittent demand or sparse demand history.

Freed Up Working Capital

Improved Service Levels



Reduced Inventory Levels

Greater Profit Margins

Improved Planner Productivity

But most of all, planners can place their trust in the system, reducing the risk of human error, minimizing planner intervention, and improving productivity.

And plenty of companies are seeing the benefits.

Eyewear manufacturer Shamir Optical incorporated probabilistic forecasting into its planning solution, creating a blend of service level targets for each individual item at each location. The company reduced inventory by more than 25% overall while consistently achieving 99+% service levels.

A probabilistic demand strategy also supports RAJA, a European leader in packaging and equipment distribution that maintains a 99% service level.

"Before ToolsGroup, we were able to generate a forecast based on average consumption over the previous three months, which was satisfactory for fast-moving items, but extremely inadequate for seasonal products, or those with very intermittent demand. Probabilistic forecasting provides more accuracy and reliability which helps us avoid stock-outs and waste while keeping service levels high."

Michela Vesta, Supply Chain & Project Manager, RAJA Italia

Learn more about how successful companies have applied probabilistic forecasting and machine learning to transform their supply chains, adapting to uncertainty, sensing and responding to change quickly, and maximizing working capital and profitability.

+ Check out these additional resources for more tips and insights:

Video: What is Probabilistic Forecasting?

Ebook: Machine Learning for Supply Chain 101

Guide: Overcoming Inventory Disruption to Maximize Service Levels and Profit

Case Study: Shamir Optical